Performance and energy requirements for Nellore bulls divergent in residual feed intake

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Dry matter intake (DMI), performance and energy requirements were evaluated in Nellore bulls from divergent classes of residual feed intake (RFI). Thirty-three Nellore bulls (15 classified as low RFI-LRFI and 18 as high RFI-HRFI), from selection and control herds of Instituto de Zootecnia, São Paulo, Brazil Nellore breeding program, were feedlot finished and slaughtered with 400±51 kg of body weight and 542±30 days of age. Eight bulls, three LRFI and five HRFI, were slaughtered at the beginning of the experiment and used as reference bulls. Individual DMI was recorded daily and initial and final body weights were recorded after 16 hours of fasting from total solids. Nine bulls, four LRFI and five HRFI, were fed at maintenance, receiving 65 g of DM/kg$^{0.75}$ BW and 16 bulls (eight LRFI and eight HRFI) were fed *ad libitum*. Diet had 19:81 roughage:concentrate, consisting of *Brachiaria* hay, ground corn, cottonseed, cottonseed meal, citrus pulp and mineral mixture, with 85% of DM and 14% of crude protein. Ultrasound measurements on the *Longissimus* muscle were performed at intervals of 28 days. When two *ad libitum* bulls reached 4 mm of subcutaneous fat thickness, one maintenance bull was randomly chosen and slaughter at the same day. After slaughter, empty body weight (EBW) was measured. Dry matter intake and animal performance were analysed using a random coefficients model. The following variables were included in the model as fixed effects: RFI class, type of feeding and breeding herds. The net and metabolisable energy requirements for maintenance (NEm; MEm) were estimated by exponentially relating heat production with metabolisable energy intake. As expected, the LRFI had lower DMI (5.43 vs 6.36 kg/d; P=0.033) than HRFI, but similar slaughter BW (385 kg; P=0.128) and ADG (0.561 kg/d; P=0.506). The NEm, MEm and the efficiency of metabolisable energy utilisation were 78.0 kcal/d/ kg$^{0.75}$ EBW, 151 kcal/d/ kg$^{0.75}$ EBW, and 51.6%, respectively, for LRFI bulls, and 76.8 kcal/d/ kg$^{0.75}$ EBW, 162 kcal/d/ kg$^{0.75}$ EBW, and 47.4%, respectively, for HRFI bulls. The LRFI bulls produced about 7% less heat than the HRFI ones. The identification and use of LRFI bulls would improve feed efficiency and efficiency of metabolisable energy utilisation without changing performance of beef cattle. Acknowledgments: FAPESP Processes 2017/06709-2, 2018/20080-2 and 2019/17714-2.

Variations in milk fatty acid profile in lactating sheep that differ in feed efficiency

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Intensive dairy production systems demand high energy inputs, which may compromise their sustainability in the current global context. Increasing feed efficiency (FE) in dairy animals would certainly help improving the competitiveness of production, but the basis of individual differences in this trait remains largely unknown. In the first analyses of an experiment conducted with the 20% most and least efficient ewes (estimated through the residual feed intake, RFI) from a group of 40 lactating Assaf sheep, we observed a greater ruminal biohydrogenation (BH) of unsaturated fatty acids (FA) in the most efficient animals. Since these differences would have an impact on milk FA profile, we hypothesised that milk FAs may also be related to FE and therefore be used as non-invasive biomarkers. Fat in milk samples was extracted and converted to FA methyl esters, which were then analysed by gas chromatography. Differences in milk FA profile between groups were evaluated by ANOVA. The most efficient ewes showed a greater concentration of FA with less than 16-carbons, which suggests enhanced de novo FA synthesis in the mammary gland. However, the milk from the least efficient animals had higher proportions of unsaturated FA, such as *cis*-9 18:1 or some 18:2 isomers, which is consistent with the previously reported differences in the extent of ruminal BH. Similarly, greater milk content of very long-chain n-6 polyunsaturated FA (e.g. 20:2n-6, 20:3n-6, 20:4n-6 or 22:4n-6) was found in these sheep. This greater content would derive from reported apparent decreases in the ruminal disappearance of dietary 18:2n-6, which is the precursor for the synthesis of other n-6 FA in body tissues. In conclusion, milk FA profile from ewes with different RFI values suggest a relationship between FE and lipid metabolism. Milk FA might be used as biomarkers for estimation of FE in dairy ewes, but further research in this field is needed. Acknowledgements: Project CSI276P18, JCyL, FEDER and ESF, UE.

Book of Abstracts of the 71st Annual Meeting of the European Federation of Animal Science

Book of abstracts No. 26 (2020)
Virtual Meeting
1-4 December 2020

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INTRODUCTION

Intensive dairy production systems demand high energy inputs, which may compromise their sustainability in the current global context.

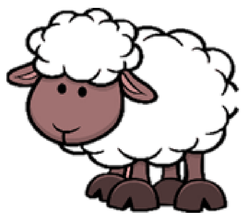
Increasing feed efficiency (FE) in dairy animals would certainly help improving the competitiveness of production, but the basis of individual differences in this trait remains largely unknown.

In the first analyses of an experiment conducted with Assaf dairy ewes divergent feed efficiency phenotypes, we observed a greater ruminal biohydrogenation (BH) of unsaturated fatty acids (FA) in the most-efficient animals.

Since these differences would have an impact on milk FA profile, we hypothesized that milk FA may also be related to feed efficiency and therefore be used as non-invasive biomarkers.

MATERIAL AND METHODS

H-FE; n=8



L-FE; n=8

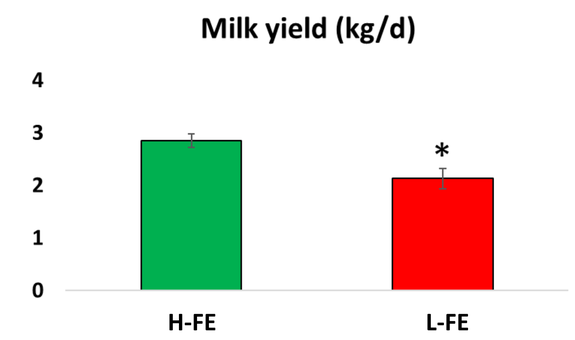
Experimental conditions: (3 weeks)
- TMR (50:50 F:C)
- Ewes allocated in individual tie stalls
- 2 milkings/day

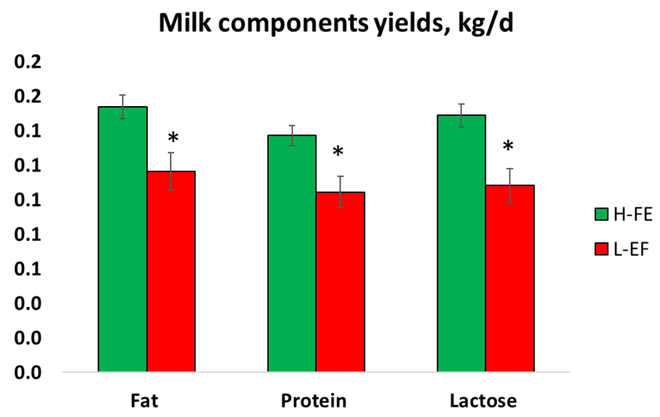
Feed efficiency was calculated as:
Actual DM intake – predicted DM intake (estimated based on AFRC metabolizable energy requirements for maintenance, production and live weight change)

Measurements and sampling procedures:

- ❑ Individual daily DM intake and milk yield
- ❑ Individual milk samples were collected during 3 consecutive days for analysis of:
  - Fat, protein, and lactose content by MIR (using a MilkoScan FT6000)
  - Fatty acid (FA) profile by GC.

RESULTS AND DISCUSSION





Milk and milk component yields were greater in the **H-FE** animals **without variations in DM**

Milk fatty acid profile

FA, g/100 g total FA	L-FE	H-FE	*P*-value
cis-9 18:1	11.835	10.205	0.05
cis-11 18:1	0.371	0.347	0.54
cis-12 18:1	0.229	0.276	0.15
trans-6+7+8 18:1	0.175	0.187	0.36
trans-9 18:1	0.206	0.177	0.27
trans-10 18:1	0.292	0.34	0.39
trans-11 18:1	0.778	0.91	0.28
trans-12 18:1	0.277	0.302	0.34
∑ C20-22 n-6 PUFA	0.256	0.183	<0.01
∑ C20-22 n-3 PUFA	0.226	0.186	0.06
∑ de novo SFA	37.8	40.1	0.06
de novo SFA/*cis*-9 18:1 ratio	3.28	3.96	0.02
Δ^9- desaturation ratios			
cis-9 10:1/10:0	0.026	0.025	0.37
cis-9 12:1/12:0	0.016	0.015	0.65
cis-9 14:1/14:0	0.013	0.012	0.46
cis-9 16:1/16:0	0.024	0.023	0.58
cis-9 17:1/17:0	0.313	0.289	0.23
cis-9 18:1/18:0	1.81	1.71	0.39
Estimated milk fat melting point, ºC	32.5	32.2	0.44

Consistent with the previously reported differences in the apparent BH extent of unsaturated FA (see companion abstract)

Differences may derive from decreases in the apparent BH extent of dietary 18:2n-6 (their precursor for body tissue synthesis)

Enhanced de novo FA synthesis in the mammary gland of **H-FE** ewes

CONCLUSIONS

Milk FA profile from ewes differing in feed efficiency (FE) suggests a relationship between this trait and lipid metabolism.
Milk FA might be used as biomarkers for FE estimation in dairy ewes, but further research in this field is needed.

Acknowledgements: Project CSI276P18, JCyL, FEDER and ESF, UE.

71st Annual Meeting of European Federation of Animal Science